Renesas Synergy™

Creating a Custom Board Support Package

Introduction

The core requirement of every SSP project is the Board Support Package (BSP). This document shows how to use the Custom BSP Creator to create a custom BSP. After creating the BSP, you can use this BSP exactly as a BSP provided with a Renesas Synergy kit.

For more information about what is provided in a BSP please refer to the *SSP User's Manual*.

Note on SSP Compatibility

Custom BSPs are only verified to work with the SSP version that they were created from. For example, a custom BSP created from SSP v1.0.0 is not verified to work with SSP v1.1.0. A custom BSP *may* be forward compatible, but in the event that it is not compatible, the user will be responsible for manually migrating their custom BSP to the new SSP version. This would typically be done by repeating the steps in this document, but using a newer SSP pack.

Contents

1. BSP Custom Creator Tool

The Custom BSP Creator is a command-line tool for creating a custom BSP that can be used in e² studio.

1.1 Why create a custom BSP?

The BSP is a requirement of every SSP project and Renesas provides BSPs for all Renesas boards. The BSP is responsible for getting the MCU from reset to the main application (the `main()` function). The BSP also provides information to the SSP modules, so that the modules can be automatically configured for your hardware. Typically, users develop an application on a Renesas Synergy board and eventually replace the Renesas-provided BSP with a custom BSP matching their custom board.

1.2 What changes with a custom BSP?

Not everything in the BSP changes when you create a custom BSP. The BSP is made up of three folders in its source tree (synergy/ssp/src/bsp):

- board

- cmsis

- mcu

The *cmsis* and *mcu* folders do not need to change for a custom BSP. The *cmsis* folder contains the CMSIS-CORE subset of the BSP. The *mcu* folder contains the source that is common to MCU groups. For example, if there are two boards that both use a S7G2 MCU then they share the *mcu/s7g2* source folder.

You will be making changes for the custom BSP in the *board* folder. Each folder in the *board* folder is specific to a particular board. When you make changes for a custom BSP, the tool creates a new folder in the *board* directory that is specific to your custom board.

There are three required files in any board folder:

- bsp.h

- bsp_init.c

- bsp_init.h

The *bsp.h* header file contains all of the necessary includes and function prototypes needed for this custom BSP. The *bsp_init.c* source file contains code that must be executed before `main()` and is specific to this board. The code in *bsp_init.c* is called when the core BSP executes the `bsp_init()`function which resides in *bsp_init.c*. The code in the `bsp_init()` function can then call other functions as needed.

Examples from boards provided by Renesas Synergy include initializing external memory, such as SDRAM and QSPI, and defining the LEDs available. The code for initializing SDRAM and QSPI is contained in *bsp_sdram.c* and *bsp_qspi.c* respectively.

There is also an XML file associated with each BSP. This file is used by e² studio to enable configuration of the BSP through the Synergy Configurator inside e² studio. The **BSP**, **Clocks**, and **ICU** tabs are data derived from the information contained in this XML file.

1.3 How does the tool work?

The figure below provides an overview of the steps involved in creating a custom BSP with the Custom BSP Creator. The procedure includes using two executables and following four basic steps.
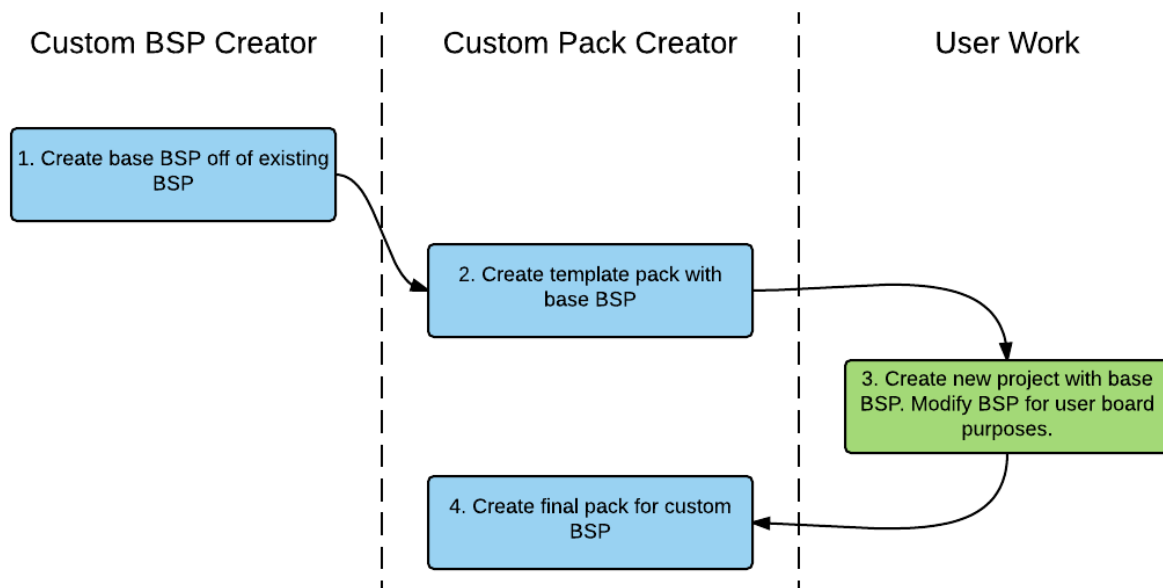
The first step is to create a base BSP to work from using the Custom BSP Creator executable, **custom_bsp_creator.exe**. In this tool you can pick an existing BSP (for example the DK-S7G2) as a base for the new custom BSP.

Running the tool creates a base BSP. This base BSP exists as a set of files and folders on your PC. To be able to use and configure the base BSP in e^2 studio, you need to create a new CMSIS Pack in step 2. CMSIS Packs are the mechanism that is used to deliver code inside e^2 studio.

To create a pack, use the Custom Pack Creator, **custom_pack_creator.exe**. This tool takes the base BSP created in the previous step and packages it, so it can be used in e^2 studio. One of the options of the tool is to create a template pack. Creating a template pack is required to make changes to the source code later in e^2 studio.

Normal, non-template packs, do not allow the source code they provide to be modified. If you modify the code, then those modifications are overwritten the next time the project is built. To disable the overwriting feature, you must create a pack that can tell e^2 studio to allow modifications.

After creating the template pack, you can modify the base BSP in e^2 studio. At this point the base BSP is still a copy of an existing BSP. The existing BSP must be modified to meet the requirements of your new custom BSP. To do so, you can create a new project in e^2 studio. Once the project is created, you can modify the BSP through the System Configurator in the same way as editing any other BSP. In addition, you can also add, modify, and remove source code from the BSP as needed. Typical updates to the BSP are:

- Pin configuration
- Stack and heap sizes
- Clock tree configuration
- Additional source in *board* directory to be run before `main()`

After making the changes, you can build and debug the project in e^2 studio.

Once the custom BSP has been tested and is ready to be finalized, you create the final pack in step 4. This step is essentially the same as step 2 except this time you are creating a standard pack instead of a template pack with the Custom Pack Creator. The BSP in this pack acts like any other BSP provided with a Renesas Synergy kit. Other users of the BSP can modify the BSP settings in the Synergy Configurator but cannot add, remove, or modify source files inside the BSP folder. The pack created from the last step can then be distributed to other team members to be used inside e^2 studio.

2.   Example walkthrough

This section shows how to create an example custom BSP based on the DK-S7G2.

2.1   Step 1: Create a base pack

To create a base pack, follow these steps:

1.   From the Windows command prompt, run *custom_bsp_creator.exe –h* to print the command line options for the tool.

```
custom_bsp_creator.exe -h
Usage: custom_bsp_creator.exe [options]
Custom BSP Creator - This script is used to provide a customized BSP based on
the user's base board and board name. The custom BSP is generated from a PACK
file (eg. To create a board named 'wolfpack' based off the S7G2-DK, run the
command: custom_bsp_creator.exe -p pack_location -b s7g2_dk -n wolfpack
-# part_number -d output
Options:
  -h, --help            show this help message and exit
  -p PACK_PATH, --pack=PACK_PATH
                        Path to pack which custom BSP will be based upon
  -l, --list_boards     Prints list of available base boards
  -b BOARD, --base_board=BOARD
                        Board which custom BSP will be based upon (eg s3a7_dk)
  -n USER_BOARD_NAME, --name=USER_BOARD_NAME
                        Name of custom board (eg wolfpack)
  -# PART_NUMBER, --part=PART_NUMBER
                        Part Number for MCU (eg R7FS7G27H2A01CBD,
                        R7FS3A77C3A01CFB, R7FS124773A01CFM)
  -d GENERATED_BSP_DESTINATION, --dest=GENERATED_BSP_DESTINATON
                        Destination path (eg C:\Users\John\Documents). Default
                        is 'tmp'.
  --verbose             Enable verbose output
```

2.   Find the available base BSPs using the *-l* option. A valid pack must be provided using *-p* option. Packs can be found under the *<e2 studio_install_directory>\internal\projectgen\arm\Packs* directory.

```
custom_bsp_creator.exe -l -p Renesas.Synergy.1.0.0.pack
s3a7_dk

s3a7_user
s7g2_dk
s7g2_pe_hmi1
s7g2_sk
s7g2_user
```

Note: This operation will take more than several seconds to complete.

3.   Create a custom BSP with the following options:

   a.   As shown previously, use the v1.0.0 pack (*Renesas.Synergy.1.0.0.pack*) for the *-p* option.

   b.   Since we are using the DK-S7G2 for the base BSP, use *s7g2_dk* as the *-b* option.

   c.   The part number of our MCU is the same as the DK-S7G2. Use *R7FS7G27H2A01CBD* for the *-#* option.

   d.   Specify the new board name as *wolfpack* using the *-n* option. Note that board names cannot include hyphens "-".

   e.   The new BSP is created in the *output* folder using the *-d* option.

f. If the *--verbose* option is not used, then no output will be generated. Enable verbose mode for this example.

```
custom_bsp_creator.exe -p Renesas.Synergy.1.0.0.pack -b s7g2_dk -# R7FS7G27H2A01CBD -n
wolfpack -d output --verbose

Using base pack Renesas.Synergy.1.0.0.pack

Decompressing Base Pack (note: this may take a second)

Pack unzipped

New pack structure used BSP extracted successfully to C:\Workspace\new_bsp\output
```

2.2   Step 2: Create a template pack

Follow these steps to create a template pack, one that will allow modifications to the BSP source code, to use the new BSP in e² studio:

1. Use the *custom_pack_creator.exe* with the *-h* option to see the command-line options.

```
custom_pack_creator.exe -h
Usage: custom_pack_creator.exe [options]
Pack Generator for Custom BSP - This is used to create a custom pack based on
a modified bsp which originated from the custom_bsp_creator script. eg)
custom_pack_creator.exe -p CUSTOM_BSP_PATH -n PACK_NAME -v 1.0.0
Options:
  -h, --help            show this help message and exit
  -p CUSTOM_BSP_PATH, --path=CUSTOM_BSP_PATH
                        Path to Custom BSP (eg C:\CustomBSP"). Folder must
                        contain 'synergy' folder. Default is current
                        directory.
  -n USER_BOARD_NAME, --name=USER_BOARD_NAME
                        Name of custom board (eg wolfpack)
  -v PACK_VERSION, --version=PACK_VERSION
                        Version Number for Generated Pack (eg 1.0.0). Default
                        is 1.0.0.
  -t, --template        Creates a pack with modifiable BSP that can be used
                        for creating final BSP
  -e E2STUDIO_PATH, --e2studio=E2STUDIO_PATH
                        Path to e2studio (eg C:\Renesas\e2_studio). Default is
                        C:\Renesas\e2_studio.
  --verbose             Enable verbose output
```

2. Before continuing, make sure that e² studio is not open. If e² studio is open during a new pack generation, the tool may fail since e² studio can have the files open.

3. Create a template pack using the following options:

    a. The base BSP is located in the *output* folder that was just created. We will provide this path for the *-p* option.

    b. The board name is *wolfpack* so we will provide that as the *-n* option

    c. For this example we will set the version using the *-v* option to *1.0.0*

    d. This is a template pack so we will use the *-t* option

    e. The path to e² studio will vary based on where you installed it. In this example we will use the e² studio installation located at *C:\Renesas\synergy-e2_studio*. This will be provided as the *-e* option.

f. Once again if *--verbose* is not provided then the tool will not output any status. We will provide the *--verbose* option.

```
custom_pack_creator.exe -p output -n wolfpack -v 1.0.0 -t -e C:\Renesas\synergy-e2_studio --verbose
Removing old release
Copying files
Generating .psdc
```

The custom pack has now been created.

2.3   Step 3: Create a new project for the BSP and modify the BSP

To configure the custom BSP follow these steps:

1. Start e^2 studio and create a new project based on this BSP. The ISDE project configurator shows the BSP template you created as selectable Board option in the Project Configuration and Project Template Selection windows.
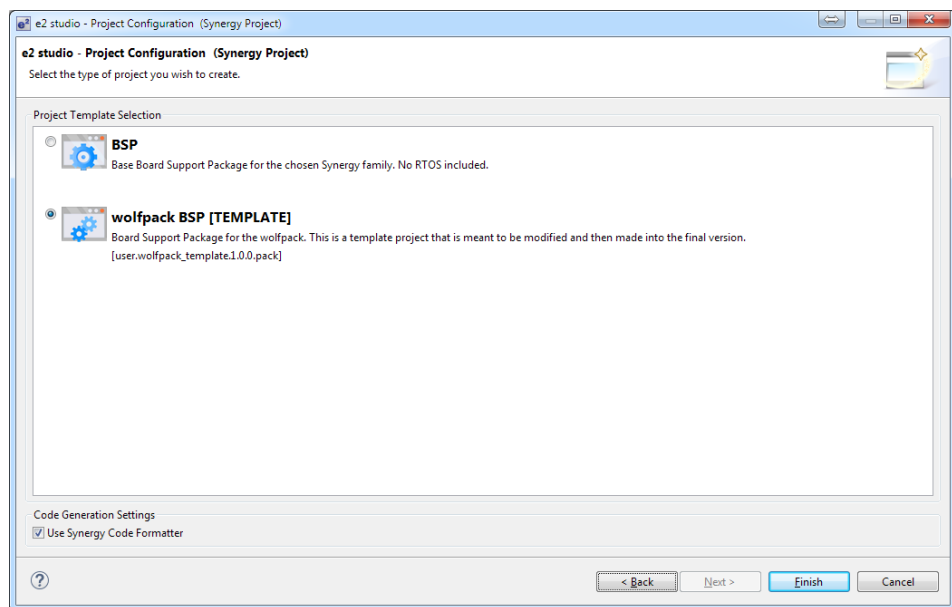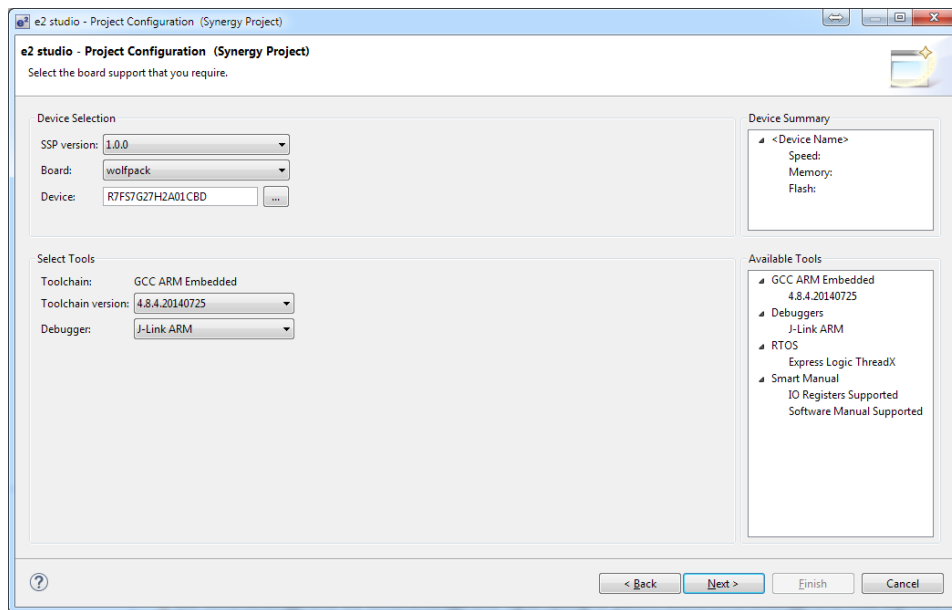
If you expand the *synergy/ssp/src/bsp/board* directory in the Project Explorer window you will see your custom board folder.
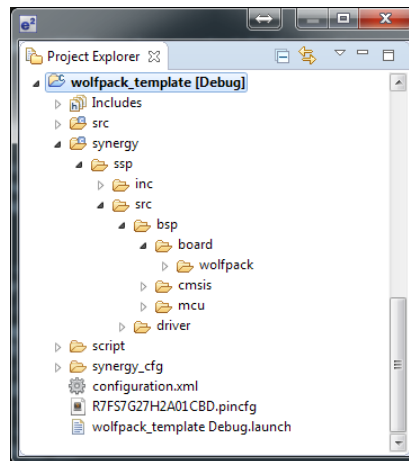
After the project has been created, e² studio must be configured to treat the BSP module as a template module. Only perform this step when working with template pack BSPs.

2. Close e² studio.

3. On your PC, navigate to the folder of the project you just created. In this example the folder was *C:\Workspace\wolfpack_template*.

4. Open the *configuration.xml* file in a text editor.

5. Find the <component> element that relates to the BSP. It is the only element with its *class* attribute set to *"BSP"*. Below is the <component> for this example.

```
<component apiversion="" class="BSP" condition="" group="USER" subgroup="wolfpack" variant=""
  vendor="Renesas" version="1.0.0">
  <description>[TEMPLATE] Board Support Package for wolfpack</description>
  <originalPack>user.wolfpack_template.1.0.0.pack</originalPack>
</component>
```

6. Under the <component> element add the following element: <template>true</template>. Using the example in the previous step the <component> now looks like this:

```
<component apiversion="" class="BSP" condition="" group="USER" subgroup="wolfpack" variant=""
  vendor="Renesas" version="1.0.0">
  <description>[TEMPLATE] Board Support Package for wolfpack</description>
  <originalPack>user.wolfpack_template.1.0.0.pack</originalPack>
  <template>true</template>
</component>
```

7. Save the file and close it.

8. Restart e² studio and reopen the project you created previously.

   WARNING: If you accidentally create a second component instead of modifying the first one, e² studio will crash.
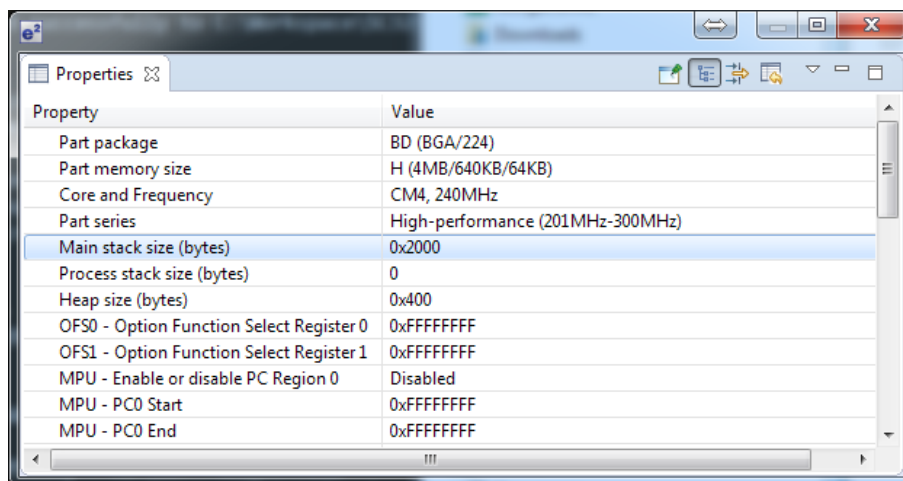
   In the next step, make modifications to the BSP to simulate the customization process.

9. Add two empty files to the synergy/ssp/src/bsp/board/wolfpack/ directory: *bsp_extra.c* and *bsp_extra.h*.
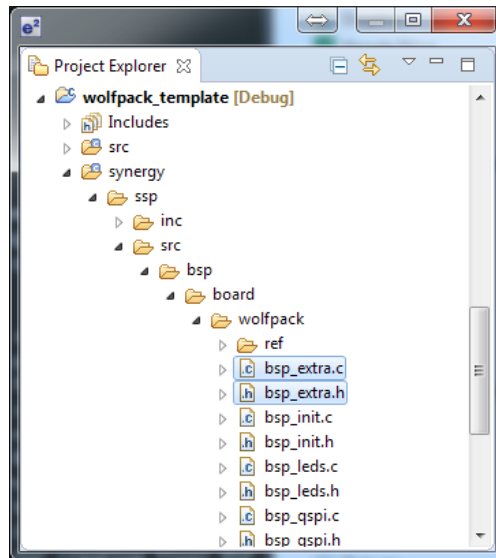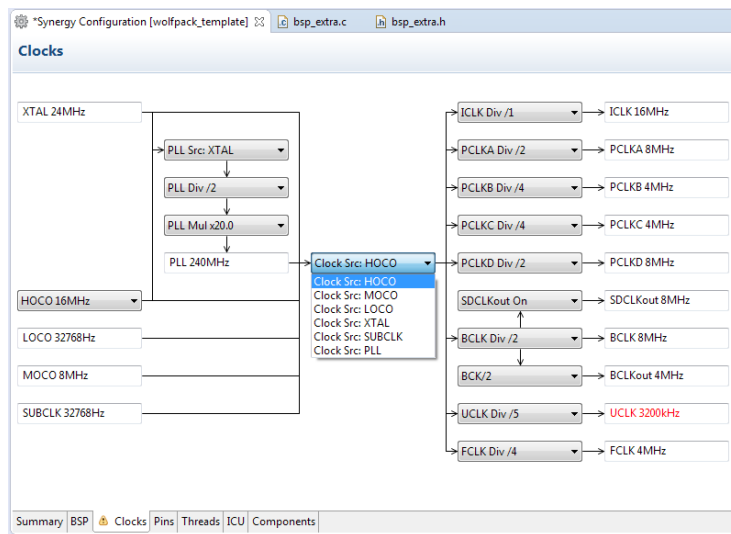

10. Open the Synergy Configurator and make the following changes:

- In **Properties** window of the **BSP** tab, change the Main Stack size to *0x2000*.
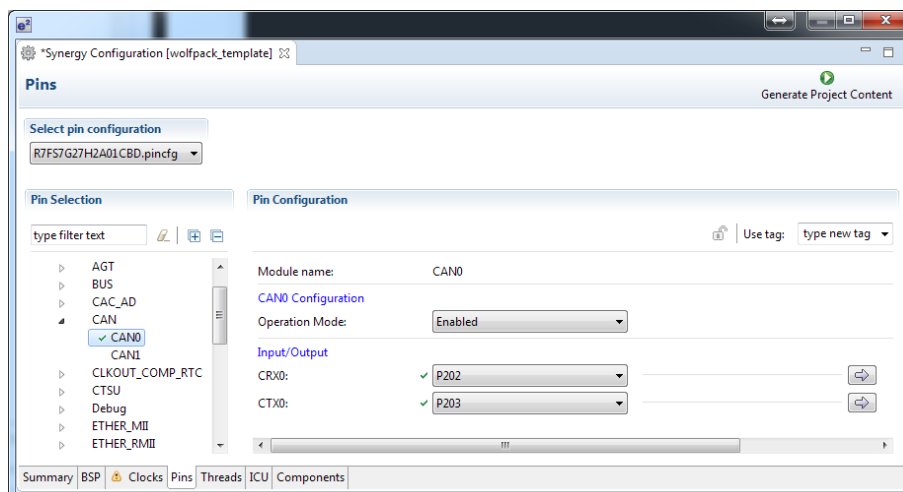
- Change the system clock source (*Clock Src*) to the HOCO.

- Enable the CAN0 pins in the Pin Configurator using the **Peripherals** view.

11. Save the changes by clicking the **Generate Project** button and build the project.

The final, customized BSP has been created. Now we need to put it in a final pack.

2.4   Step 4: Create the final pack

You can now create a final, non-template, pack with the Custom Pack Creator. Remember to close e² studio before performing this step. Go through the previous steps with the following differences:

- The path to the custom BSP is now below the root of the project you created in earlier steps. For this example, we will assume the project was created under *C:\Workspace\wolfpack_template*. There must be a *synergy* directory in the path that is given to the tool.

- Since this pack will not be a template we will remove the *-t* option that we used previously.

```
custom_pack_creator.exe -p C:\Workspace\wolfpack_template -n wolfpack -v 1.0.0
                        -e C:\Renesas\synergy-e2_studio --verbose
```
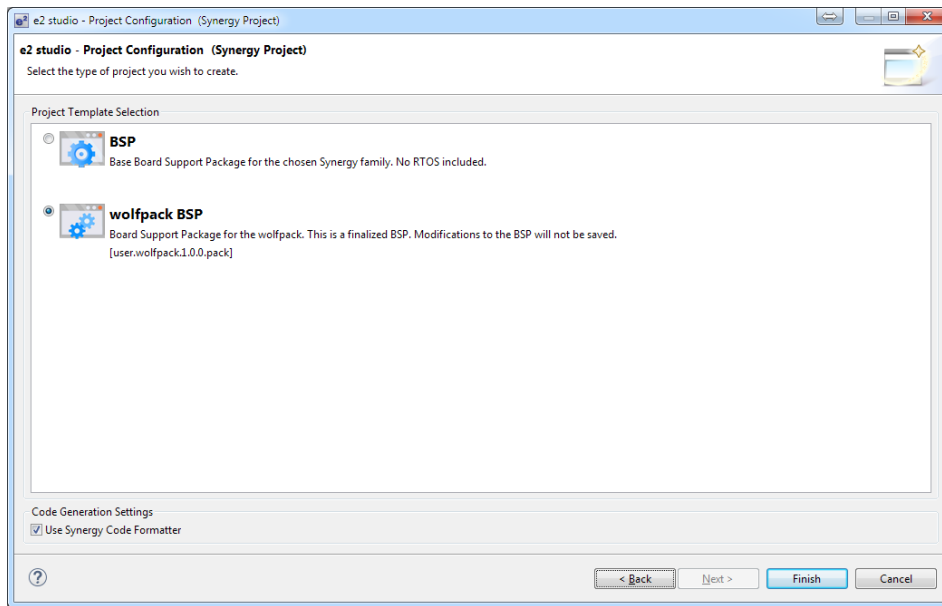
Removing old release

Copying files

Generating .psdc

Before using the final template, remove the template pack from e² studio:

Navigate to *<e2 studio_install_directory>\internal\projectgen\arm\Packs* and delete the template pack or move it outside of the e² studio directory. For this example the name of the pack is *user.wolfpack_template.1.0.0.pack*.

Open up e² studio and create a new project based on the new custom board.

Once the project has been created, verify that the changes made to the template are still in the new project.

To verify that this is the final pack, delete the *bsp_extra.c* and *bsp_extra.h* files in the *synergy/ssp/src/bsp/board/wolfpack/* directory. After deleting the files, build the project and verify that the files are brought back into the project.

You have now a created a custom BSP. To share this BSP, you can distribute the newly created pack in the *<e2 studio_install_directory>\internal\projectgen\arm\Packs* directory. For this example, the name of the final pack is *user.wolfpack.1.0.0.pack*.

Website and Support

Support: https://synergygallery.renesas.com/support

Technical Contact Details

- America: https://renesas.zendesk.com/anonymous_requests/new
- Europe: http://www.renesas.eu/support/index.jsp
- Japan: http://japan.renesas.com/contact/index.jsp

Revision History

| Rev. | Date | Description | |
		Page	Summary
1.0	October 12, 2015	-	Initial Version
1.01	October 16, 2015	All	Minor editorial updates
1.02	January 12, 2016	12	Support URL updated.
1.03	June 27, 2016	-	Minor typos fixed. Updates based on latest pack creator.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.

2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.

3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.

5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.

   Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.

6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.

7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.

8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.

10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.

11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.

12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

RENESAS

Renesas Electronics Corporation

http://www.renesas.com